

*John Day Fall Chinook
Mitigation Evaluation
Spring Creek National
Fish Hatchery*

Brood Years 1972 - 1975

United States Department of the
Interior

U.S. Fish and Wildlife Service
Fisheries Assistance Office

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by

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INTRODUCTION

Construction of the John Day Dam on the Columbia River, and subsequent filling of the storage reservoir, resulted in the loss of 77 miles of anadromous fish spawning and rearing habitat. The John Day Reservoir extends from the dam (river mile 215.6) upstream to McNary Dam (river mile 292.6). It was established that the Army Corps of Engineers (COE) would mitigate for annual losses associated with the construction of the project that amounted to 60,000 adult fall chinook salmon, (*Oncorhynchus tshawytscha*), returning to the Columbia River. This included an estimated 30,000 fish which spawned in the inundated area, plus an additional 30,000 adult fish destined for the inundated area that were harvested in the river below John Day Dam.

The COE entered into an agreement with the U.S. Fish and Wildlife Service (USFWS) in 1972, to increase smolt production at Spring Creek National Fish Hatchery (SCNFH) to mitigate for one half of the losses (30,000 returning adults) associated with the John Day Project. This facility is located approximately 49 miles downstream from John Day Dam at river mile 166.2. In addition to funding the expansion of the facility, the COE also provided operation and maintenance funds for the increased production. Funding to operate the "other half" of the facility is provided by National Marine Fisheries Service (NMFS) as part of a program to enhance fall chinook runs in the Columbia River under authority of the Mitchell Act. Due to the sharing of operation and maintenance costs, and the inability to separate mitigation fish from Mitchell Act fish, one half of the returning hatchery adults for purposes of this analysis are considered as John Day mitigation. Therefore, this analysis assumes an overall goal for SCNFH production of 60,000 adult fish returning to the Columbia River. Returns by brood year were used in this evaluation since annual returns to the river were composed of varying age classes, and not enough years of comparable age classes were available.

As part of the John Day mitigation program the USFWS also received funds to conduct an evaluation of the success of the hatchery in meeting its mitigation goal. A marking study was initiated in 1972 to evaluate the contribution to the river of production fish released at the hatchery. Twenty five tag codes were used to analyze the contribution of Spring Creek Hatchery fish. Sixteen of these groups represent the general hatchery production and nine groups were used in association with experiments carried out at the hatchery. All mark groups released at the hatchery between 1973 and 1976 are included in this analysis, however the experimental fish were considered as separate segments of the population and as such represent only the fish in the experimental group.

These experimental fish are included because they are part of the production of the hatchery and as such contribute to the overall mitigation.

As stated above this study evaluates returns to the Columbia River of SCNFH chinook adults. Analysis of the contribution of hatchery production to the river includes recovery information available from all in-river fishery recovery sites, hatchery returns and recovery of "stray tags" returning to hatcheries other than SCNFH.

METHODS

The 1972 through 1975 brood year releases were used in the study. All fish were Spring Creek Hatchery origin stock except for the 1972 brood when one half was Toutle River stock due to a poor egg take at the hatchery.

The binary coded wire tag (cwt) manufactured by Northwest Marine Technology was used to mark the fish. Marking took place at the hatchery from approximately March 1st to April 30th. Due to the lengthy marking period the fish marked during the study ranged in size from approximately 175 fish/lb. to 90 fish/lb. A predetermined number of fish from each release group was randomly selected for marking. The number of fish per group in the 1972 and 1973 broods was 250,000; this number was reduced to 100,000 per group for the 1974 and 1975 broods. It was determined that a 100,000 fish per mark group would result in a sufficient number of recoveries for our evaluation.

Fish for marking were crowded into one end of each pond and randomly captured. The weight of the fish (fish/pound) was used to determine the number of fish held for marking. The actual percentage of fish marked from each release group ranged from 1 to 10 percent throughout the study.

Fish to be tagged were transported to the hatchery building where they were anesthetized with a benzocaine alcohol solution. The anesthetized fish were fin clipped and a cwt was injected into their snout. Removal of an adipose fin was used as a visual mark to identify a fish having a cwt. After marking, each fish was routed through a quality control device (QCD) which automatically rejected any fish not having a cwt. Fish rejected by the QCD were reprocessed until a tag was implanted. After the tagged fish recovered from the anesthetic, they were returned to a rearing pond via a 6-inch aluminum pipe by gravity flow. Each group of tagged fish was kept in a pond separate from the unmarked group until release.

Before release, each group of fish was checked for tag retention. Because of the short time between marking and release for the March releases, tag retention samples were taken only one or two days after tagging. Later releases were checked immediately after marking and then rechecked 7-10 days later. In the case of the late summer and early fall releases a third retention sample was conducted a few days prior to release. Tag retention was determined by crowding all the fish to one end of the pond and randomly obtaining a sample of between 300 and 500 adipose clipped fish. The presence or absence of a tag was determined by using a field tag detector. A percentage of tag loss was calculated from the sample for each tag group.

The number of fish released in an unmarked group was determined at the time of release by standard hatchery methods. This involved keeping track of the daily mortalities in each pond and subtracting these from the original number of fish ponded. Samples of fish from each pond were routinely counted and weighed to ascertain the fish/pound. This size figure was also used to estimate the number of fish at release.

Daily mortality counts were kept on each pond to determine the number of marked fish released. The number released was calculated by subtracting the mortalities from the original number of marked fish. Table 1 lists the release information for all four brood years.

Recovery of Tags in the Fisheries

Marked fish were recovered from the in-river fisheries through a mark recovery program conducted by Oregon Department of Fish and Wildlife (ODFW), USFWS, Washington Department of Fisheries (WDF), Washington Department of Game (WDG), and NMFS. The goal of the sampling program was to maintain at least a 20% sampling rate. The actual sampling rate was calculated for each time period by dividing the number of fish checked for marks by the total catch. Samplers monitored the commercial catch at the buying stations and obtained length, weight, sex, and type of mark. In addition the snout was removed from all fish with a missing adipose fin. Sport fisheries for chinook in the Columbia River were monitored through the on going creel census conducted by ODFW and WDF.

The ODFW served as the cwt processing center for in-river tag recoveries, and decoded the tags. The tags were then returned to the Fish and Wildlife Service where the tag code readings were verified. Oregon Department of Fish and Wildlife estimated the number of marked fish caught by river area for each tag code. This information was forwarded to the Pacific Marine Fisheries Commission (PMFC) and published in their annual recovery reports (prior to 1977, ODFW published the recovery reports). Information from the recovery reports that was utilized in this analysis appears in Appendix Tables 1 through 16.

Additionally, during mark sampling at ODFW's Bonneville Hatchery in 1978 and 1979 tags were recovered from SCNFH fish which "strayed" into the hatchery. These tags will be listed with the lower river tag recovery information in Appendix Tables 9 and 13.

Recovery of Tags at the Hatchery

All fish returning to the hatchery were sampled for marks. Length and sex data were collected for each marked fish and the snout removed. This information was also obtained from a 10% sample of the unmarked fish for use in determining their age and sex composition.

The tags retrieved through 1979 were read by personnel from the USFWS's Lower Columbia River Fish Health Center. The 1980 recoveries were retrieved and read at Fisheries Assistance Office, Vancouver, Washington.

Table 1. Summary of time and size at release, numbers released marked and unmarked and tag retention rates for the 1972 through 1975 fall chinook brood years released from Spring Creek National Fish Hatchery.

Mark or Tag Code	Brood Year	Release Date	Release Size	# Marked Released	Tag Retention	# Marked w/Tags Released	# Unmarked Released	Total Release	Tag Ratio
Unmarked <u>1/</u>	1972	3-29-73	120/1b	0	NA	0	3,228,000	3,228,000	NA
5-1-1	1972	4-13-73	78/1b	266,599	95.0%	253,269	4,596,020	4,862,619	.052
5-2-1	1972	5-11-73	58/1b	243,199	94.2%	229,093	3,539,100	3,782,299	.061
5-3-1	1972	5-11-73	58/1b	260,701	96.6%	251,837	0	260,701	.966
Unmarked <u>1/</u>	1972	5-22-73	58/1b	0	NA	0	7,821,985	7,821,985	NA
LV-adipose	1972	5-22-73	58/1b	281,113	NA	NA	0	281,113	NA
Total for Brood Year	1972 <u>2/</u>	NA	NA	770,499 <u>4/</u>	NA	734,199	19,185,105	20,236,717	NA
5-4-1	1973	3-21-74	90/1b	239,391	96.5	231,012	3,363,210	3,602,601	.064
5-5-1	1973	4-18-74	91/1b	254,641	94.1	231,148	3,573,016	3,782,657	.063
5-6-1	1973	4-18-74	91/1b	251,341	96.0	241,287	0	251,341	.960
Unmarked <u>1/</u>	1973	4-21-74	130/1b	0	NA	0	600,591	600,591	NA
5-7-1	1973	4-25-74	130/1b	232,186	95.0	220,573	0	232,186	.950
5-8-1	1973	4-25-74	130/1b	241,076	95.0	229,022	2,551,634	2,792,710	.082
Unmarked <u>1/</u>	1973	5-7-74	71/1b	0	NA	0	6,007,305	6,007,305	NA
Total for Brood Year	1973 <u>3/</u>	NA	NA	1,218,635	NA	1,153,042	16,095,756	17,269,387	NA

Notes on Releases:

1/ Not used in contribution analysis.

2/ The 1972 brood year was in good health. There was evidence of redmouth but fish were in good condition throughout rearing. The overall mortality rate from time of ponding to time of release was 5%.

3/ The 1973 brood year was suffering from redmouth and bacterial gill disease throughout the rearing period. The overall mortality rate from time of ponding to time of release was 17%. Some releases were made earlier than scheduled because of excessive mortality.

4/ Does not include fish marked w/AD-LV clip.

Table i (Continued)

Mark or Tag Code	Brood Year	Release Date	Release Size	# Marked Released	Tag Retention	# Marked w/Tags Released	# Unmarked Released	Total Release	Tag Ratio
5-9-1	1974	4-2,3-75	105/1b	102,810	96.0	98,698	5,280,010	5,382,820	.018
5-10-1	1974	4-2,3-75	135/1b	98,775	95.7	94,527	4,234,538	4,333,313	.022
5-11-1	1974	5-21-75	62/1b	103,743	97.0	100,631	3,631,878	3,735,621	.027
5-12-1	1974	5-21-75	62/1b	97,027	94.4	91,593	0	97,027	.944
5-13-1	1974	5-21-75	57/1b	100,407	96.3	96,722	4,323,789	4,424,196	.022
5-14-1	1974	5-21-75	57/1b	101,452	96.7	98,104	0	101,452	.967
5-15-1	1974	8-25,26-75	12/1b	101,646	95.0	96,564	878,954	980,600	.098
Total for Brood Year	1974 <u>5/</u>	NA	NA	705,860	NA	676,839	18,349,169	19,055,029	NA
5-1-2	1975	3-18,19-76	89/1b	101,626	95.0	96,753	0	101,626	.952
5-2-2	1975	3-18,19-76	115/1b	103,656	97.1	100,608	10,083,087	10,186,743	.010
5-3-2	1975	4-12-76	80/1b	102,503	93.7	96,016	2,758,540	2,861,043	.034
5-4-2	1975	4-12-76	72/1b	102,863	96.9	99,647	0	102,863	.964
5-5-2	1975	4-12-76	87/1b	103,938	97.2	101,080	0	103,938	.972
5-6-2	1975	4-12-76	79/1b	99,422	94.6	94,137	0	99,422	.946
5-7-2	1975	5-7-76	57/1b	102,795	97.9	100,653	2,967,054	3,069,849	.033
5-8-2	1975	5-7-76	57/1b	98,356	98.6	96,964	0	98,356	.986
5-9-2	1975	8-25-76	11/1b	52,292	95.3	49,860	428,198	480,490	.104
5-10-2	1975	9-30-76	9/1b	52,246	91.7	47,929	394,091	446,337	.107
Total for Brood Year	1975 <u>6/</u>	NA	NA	919,697	NA	883,647	16,630,970	17,550,667	NA

Notes on Releases:

5/ 1974 brood fish were in generally good health. The overall mortality rate was 5%.

6/ 1975 brood fish were suffering from redmouth and generally in fair condition. Overall mortality for this brood was 11%.

Estimating Returns to Fisheries

The contribution of SCNFH chinook adults to the river fisheries was estimated using data from the 1975 and 1976 ODFW recovery reports, the 1977 and 1978 PMFC recovery reports, and recovery data collected in 1979 and 1980 by the ODFW Biometrics Section. Estimates of the number of tags recovered in the commercial fisheries for a given time period were made using the number of fish caught in the fishery, the number of fish sampled for marks, and the number of tags recovered.

The total number of hatchery fish (by release group) taken in each of the river fisheries was estimated using the following procedure:

- (1) An estimate of the number of Spring Creek Hatchery cwt fish taken by time period in a given fishery was obtained from ODFW.
- (2) The actual number of cwt fish in a particular release group was determined by reducing the original number of marked fish by a measured tag loss and known mortality at the hatchery. The actual number of cwt fish released was then divided by the total number of fish released to determine the tag ratio. The tag ratio for each release group is presented in Table 1.
- (3) The the total contribution of Spring Creek Hatchery fish to a particular fishery was calculated by dividing the estimated number of marked fish occurring in the harvest by the tag ratio.

Estimating Returns to the Hatchery

The return of adult chinook to the hatchery was estimated using the data collected from the marked fish returning to the hatchery and the tag ratio as was done for the fisheries. This was necessary since during the first two years, not all release groups were represented by marked fish, and/or straying was expected due to off station releases during the last two years.

Estimating Returns to Other Hatcheries

The amount of SCNFH fish that returned to ODFW's Bonneville Hatchery from the brood years being evaluated was estimated using the sampling data collected from fish returning to the hatchery and the tag ratio, as the estimates of returns to Spring Creek were made.

Assumptions

The following basic assumptions were made for this evaluation:

1. The marked portion of the release group is representative of the whole group. Without a representative sample, inferences made about the release group may be biased. Fish were randomly selected from each pond to ensure that marked groups were representative.

2. All marked fish retain their visual mark (missing fin) throughout life. Marked fish were monitored to assure total removal of the adipose fin in order to eliminate possible regeneration. The occurrence of naturally missing adipose fins was monitored, and considered to be negligible.
3. The loss of tags after release is negligible. Tag loss until release was monitored, and the number of tags lost estimated.
4. There is no differential mortality between marked and unmarked fish after release. Marked fish were monitored after marking until they were released to determine if any added mortality occurred. At time of release mortalities occurring in marked groups and unmarked groups were similar.
5. The ratio of marked to unmarked fish at release remains constant throughout their life.

Sources of Variation

During the analysis of data obtained from this study, the following potential sources of variation were identified:

1. The tag retention values for some of the release groups may have been overestimated due to the short time between tagging and/or release of the March groups, and/or the small tag retention sample sizes.
2. The release of approximately 50% of the production from the 1972 and 1973 brood years without being marked did not allow an estimation of the total contribution of those brood years.
3. The reduction in fish per group from 250,000 to 100,000 marked fish resulted in different pond densities between the marked and unmarked groups during the last two years compared to the first two years of the study.
4. The degree of sampling varied within a given fishery; between fisheries; and between the different return years. In addition the expertise and/or technique involved in accurately sampling the fisheries had not been fully developed in the early recovery phase of the study.
5. The effects of handling stress on the fish may not have been accurately assessed in some cases, and groups released shortly after marking may have incurred delayed handling mortalities that were not quantified.

RESULTS AND DISCUSSION

During the study a total of 56,172,810 fall chinook were released from the hatchery which were represented by various tag codes. Of this total 3,447,727 fish were marked for this evaluation.

During the recovery phase of the study, the sampling rate for the non-Indian commercial fishery, sport fishery below Bonneville Dam, and the Indian set net fishery was 15%, 7%, and 12% respectively. Between 1975 and 1980 a total of 78,352 adults returned to the hatchery and were sampled for marks.

A total of 1,560 tags were recovered during the evaluation from the various river fisheries. Of these 849 were recovered in the Indian set net fishery above Bonneville Dam, and 711 in the non-Indian drift net fishery below Bonneville Dam. No tags were recovered in the lower river sport catch. An earlier marking study (Wahle and Vreeland 1978) found that SCNFH fall chinook did not contribute to the lower Columbia River sport harvest. In addition a total of 3,061 tags were recovered at the hatchery. An additional 12 tags from the Spring Creek study groups were retrieved in 1978 and 1979 during mark sampling at ODFW's Bonneville Hatchery. Mark sampling data for Bonneville Hatchery before 1978 are not available for analysis; information from 1980 indicates no tags from the study were retrieved that year. During the 1978, 1979 and 1980 sampling periods, 100% of the fish returning to Bonneville Hatchery were sampled for marks. Numbers of fish sampled for marks were 34,122, 21,232 and 21,393 respectively.

The Spring Creek Hatchery adult returns to the river for the 1974 and 1975 broods were 77,474 and 35,817 respectively. The 1972, and 1973 brood year adult returns to the river were 125,597 and 34,060 respectively for the portion of the releases that were represented by cwt groups. On a yearly basis, the 1972 and 1974 broods returned at a level that met the overall goal of 30,000 returning adults. The 1975 brood only returned half the required number of fish. The actual total return from the 1973 brood year cannot be determined as stated earlier; however based upon the age classes returning to the hatchery in 1976 and 1977, and identification of the portion of those fish represented by marks, it appears that the unrepresented returns may have returned to the river at the same magnitude as the marked releases. If this is the case, the mitigation goal in 1973 was probably reached. Table 2 summarizes the estimated adult returns by recovery point.

Based upon mortality rates during the rearing period at the hatchery, the 1972 brood exhibited the best survival, even though there was Enteric Redmouth present in the population.

GENERAL COMMENTS

This study was one of the first major hatchery contribution studies conducted on the Columbia River that utilized coded wire tags. During the early years of the study coordinated sampling of several fisheries by various agencies was still being developed. Changes in some procedures occurred during the study such as rate of marking, and different sampling rates for the fisheries. In addition not all releases were represented by a marked group; consequently a similar data base was not available for all four brood years. It must be stressed however, that the evaluation was conducted utilizing the best possible methods and data available, and the conclusions drawn from the study are valid.

Table 2. Estimated contribution of adult Spring Creek fall chinook to the Zones 1-5 and Zone 6 fisheries and returns to the hatchery.

Brood Year And Recovery Point	Estimated Return of Adult Fish By Year						Return Rate to Hatchery	Survival Rate to Mouth of Columbia
	1975	1976	1977	1978	1979	1980		
<u>1972: 1/</u>								
Zones 1-5	20,226	7,784	753				28,763	
Zone 6	39,636	35,306	0				74,942	
Hatchery	13,749	7,807	336				21,892	.246%
Total	<u>73,611</u>	<u>50,897</u>	<u>1,089</u>				<u>125,597</u>	1.410%
<u>1973: 1/</u>								
Zones 1-5		6,681	1,812	66			8,559	
Zone 6		20,233	1,720	61			22,014	
Hatchery		2,230	1,244	13			3,487	.033%
Total		<u>29,144</u>	<u>4,776</u>	<u>140</u>			<u>34,060</u>	.319%
<u>1974:</u>								
Zones 1-5 2/			23,572	6,751	194		30,517	
Zone 6			17,898	11,418	436		29,752	
Hatchery			11,508	5,503	194		17,205	.090%
Total			<u>52,978</u>	<u>23,672</u>	<u>824</u>		<u>77,474</u>	.406%
<u>1975:</u>								
Zones 1-5 2/				7,268	3,945	10	11,223	
Zone 6				10,211	4,028	100	14,339	
Hatchery				8,129	2,126	--	10,255	.058%
Total				<u>25,608</u>	<u>10,099</u>	<u>110</u>	<u>35,817</u>	.204%

1/ Represents approximately one half the production due to unrepresented releases.

2/ Includes one fish from the 1974 brood and 284 fish from the 1975 brood that strayed into Bonneville Hatchery.

The major objective of the study was to determine if the expansion of SCNFH mitigated for one-half the adult losses (30,000 fish) associated with the John Day Lock and Dam project.

Based on the estimated return from four brood years, the hatchery definitely met its mitigation goal (in terms of numbers of fish) with the 1972 and 1974 broods and probably met the goal in 1973. The 1975 brood did not meet the goal. Although the numerical mitigation goal may have been met in three out of the four brood years evaluated, the Fish and Wildlife Service position is that mitigation for project related fish losses should be "in-place" whenever feasible. To provide mitigation to all user groups that suffered losses associated with construction of the John Day Lock and Dam project, the hatchery releases must be accomplished in a manner that return adult fall chinook to the John Day Reservoir. Since presently all adult fish are destined to return to the hatchery, even in years when the desired number of fish enter the river, mitigation by our definition is not being accomplished.

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APPENDIX

Appendix Table 1. Observed and estimated recoveries of tags from 1972 brood year Spring Creek NFH adult chinook and estimates of their contribution to the Zones 1-5 fisheries.

Recovery Year	Tag Code			All Codes
	1/1	2/1	3/1	
<u>1975</u>				
Observed Tags	59	34	21	114
Estimated Tags	690	407	275	1372
Estimated Contrib.	13269	6672	285	20226
<u>1976</u>				
Observed Tags	37	32	46	115
Estimated Tags	348	332	530	1210
Estimated Contrib.	3038	4197	549	7784
<u>1977</u>				
Observed Tags	5	1	2	8
Estimated Tags	35	4	14	53
Estimated Contrib.	673	66	14	753
<u>Total (1975-1977)</u>				
Observed Tags	101	67	69	237
Estimated Tags	1073	743	819	2635
Estimated Contrib.	16980	10935	848	28763

Appendix Table 2. Observed and estimated recoveries of tags from 1972 brood year Spring Creek NFH adult chinook and estimates of their contribution to the Zone 6 fisheries.

Recovery Year	Tag Code			All Codes
	1/1	2/1	3/1	
<u>1975</u>				
Observed Tags	44	34	25	103
Estimated Tags	1235	922	744	2901
Estimated Contrib.	23750	15115	771	39636
<u>1976</u>				
Observed Tags	83	65	56	204
Estimated Tags	1122	794	688	2604
Estimated Contrib.	21577	13016	713	35306
<u>1977</u>				
Observed Tags	0	0	0	0
Estimated Tags	0	0	0	0
Estimated Contrib.	0	0	0	0
<u>Total (1975-1977)</u>				
Observed Tags	127	99	81	307
Estimated Tags	2357	1716	1432	5505
Estimated Contrib.	45327	28131	1484	74942

Appendix Table 3. Observed and estimated recoveries of tags from 1972 brood year Spring Creek NFH adult chinook and estimates of their contribution to hatchery.

Recovery Year	Tag Code			All Codes
	1/1	2/1	3/1	
<u>1975</u>				
Observed Tags	502	246	60	808
Estimated Tags	502	246	60	808
Estimated Contrib.	9654	4033	62	13749
<u>1976</u>				
Observed Tags	264	164	40	468
Estimated Tags	264	164	40	468
Estimated Contrib.	5077	2689	41	7807
<u>1977</u>				
Observed Tags	7	12	4	23
Estimated Tags	7	12	4	23
Estimated Contrib.	135	197	4	336
<u>Total (1975-1977)</u>				
Observed Tags	773	422	104	1299
Estimated Tags	773	422	104	1299
Estimated Contrib.	14866	6919	107	21892
% Return to Hatchery	.306	.183	.041	.246

Appendix Table 4. Observed and estimated recoveries of tags from 1972 brood year Spring Creek NFH adult chinook and estimates of their contribution to all areas (includes hatchery).

Recovery Year	Tag Code			All Codes
	1/1	2/1	3/1	
<u>1975</u>				
Observed Tags	605	314	106	1025
Estimated Tags	2427	1575	1079	5081
Estimated Contrib.	46673	25820	1118	73611
<u>1976</u>				
Observed Tags	384	261	142	787
Estimated Tags	1734	1290	1258	4282
Estimated Contrib.	29692	19902	1303	50897
<u>1977</u>				
Observed Tags	12	13	6	31
Estimated Tags	42	16	18	76
Estimated Contrib.	808	263	18	1089
<u>Total (1975-1977)</u>				
Observed Tags	1001	588	254	1843
Estimated Tags	4203	2881	2355	9439
Estimated Contrib.	77173	45985	2439	125597
% Return to Mouth of Columbia	1.587	1.216	.936	1.410

Appendix Table 5. Observed and estimated recoveries of tags from 1973 brood year Spring Creek NFH adult chinook and estimates of their contribution to the Zones 1-5 fisheries.

Recovery Year	Tag Codes					All Codes
	4/1	5/1	6/1	7/1	8/1	
<u>1976</u>						
Observed Tags	16	16	17	2	2	51
Estimated Tags	186	204	180	24	27	621
Estimated Contrib.	2906	3238	187	25	325	6681
<u>1977</u>						
Observed Tags	10	5	7	4	2	28
Estimated Tags	59	41	49	28	13	190
Estimated Contrib.	922	651	51	29	159	1812
<u>1978</u>						
Observed Tags	0	1	1	0	0	2
Estimated Tags	0	4	3	0	0	7
Estimated Contrib.	0	63	3	0	0	66
<u>Total (1976-1978)</u>						
Observed Tags	26	22	25	6	4	81
Estimated Tags	245	249	232	52	40	818
Estimated Contrib.	3828	3952	241	54	484	8559

Appendix Table 6. Observed and estimated recoveries of tags from 1973 brood year Spring Creek NFH adult chinook and estimates of their contribution to the Zone 6 fisheries.

Recovery Year	Tag Codes					All Codes
	4/1	5/1	6/1	7/1	8/1	
<u>1976</u>						
Observed Tags	58	32	43	6	4	143
Estimated Tags	801	414	554	77	40	1886
Estimated Contrib.	12516	6571	577	81	488	20233
<u>1977</u>						
Observed Tags	2	2	1	1	0	6
Estimated Tags	54	50	56	23	0	183
Estimated Contrib.	844	794	58	24	0	1720
<u>1978</u>						
Observed Tags	0	0	0	0	1	1
Estimated Tags	0	0	0	0	5	5
Estimated Contrib.	0	0	0	0	61	61
<u>Total (1976-1978)</u>						
Observed Tags	60	34	44	7	5	150
Estimated Tags	855	464	610	100	45	2074
Estimated Contrib.	13367	7365	735	105	569	22014

Appendix Table 7. Observed and estimated recoveries of tags from 1973 brood year Spring Creek NFH adult chinook and estimates of their contribution to hatchery.

Recovery Year	Tag Codes					All Codes
	4/1	5/1	6/1	7/1	8/1	
<u>1976</u>						
Observed Tags	102	29	51	12	9	203
Estimated Tags	102	29	51	12	9	203
Estimated Contrib.	1594	460	53	13	110	2230
<u>1977</u>						
Observed Tags	40	30	32	11	8	121
Estimated Tags	40	30	32	11	8	121
Estimated Contrib.	625	476	33	12	98	1244
<u>1978</u>						
Observed Tags	0	0	0	1	1	2
Estimated Tags	0	0	0	1	1	2
Estimated Contrib.	0	0	0	1	12	13
<u>Total (1976-1978)</u>						
Observed Tags	142	59	83	24	18	326
Estimated Tags	142	59	83	24	18	326
Estimated Contrib.	2219	936	86	26	220	3487
% Return to Hatchery	.062	.025	.034	.011	.008	.033

Appendix Table 8. Observed and estimated recoveries of 1973 brood year Spring Creek NFH adult chinook and estimates of their contribution for all areas (includes hatchery).

Recovery Year	Tag Codes					All Codes
	4/1	5/1	6/1	7/1	8/1	
<u>1976</u>						
Observed Tags	176	77	111	20	15	399
Estimated Tags	1089	647	785	113	76	2640
Estimated Contrib.	17016	10269	817	119	923	29144
<u>1977</u>						
Observed Tags	52	37	40	16	10	155
Estimated Tags	153	121	137	62	21	494
Estimated Contrib.	2391	1921	142	65	257	4776
<u>1978</u>						
Observed Tags	0	1	1	1	2	5
Estimated Tags	0	4	3	1	6	14
Estimated Contrib.	0	63	3	1	73	.140
<u>Total (1976-1978)</u>						
Observed Tags	228	115	152	37	27	559
Estimated Tags	1242	772	925	176	103	3218
Estimated Contrib.	19407	12253	962	185	1253	34060
% Return to Mouth of Columbia	.539	.324	.368	.080	.045	.319

Appendix Table 9. Observed and estimated recoveries of tags from 1974 brood year Spring Creek NFH adult chinook, estimates of their contribution to the Zones 1-5 fisheries and estimated straying to Bonneville Hatchery.

Recovery Year	Tag Codes							All Codes
	9/1	10/1	11/1	12/1	13/1	14/1	15/1	
<u>1977</u>								
Observed Tags	12	13	25	26	14	40	13	143
Estimated Tags	92	118	213	252	84	307	79	1145
Estimated Contrib.	5111	5364	7889	267	3818	317	806	23572
<u>1978</u>								
Observed Tags	4	9	10	9	11	23	15	81
Estimated Tags	14	41	40	35	42	88	58	318
Estimated Contrib.	778	1863	1481	37	1909	91	592	6751
<u>1979</u>								
Observed Tags								
1-5 Fisheries	0	0	1	1	0	0	1	3
Bonn. Hatchery						1		1
Estimated Tags								
1-5 Fisheries	0	0	4	4	0	0	4	12
Bonn. Hatchery						1		1
Estimated Contrib.								
1-5 Fisheries	0	0	148	4	0	0	41	193
Bonn. Hatchery						1		1
<u>Total (1977-1979)</u>								
Observed Tags	16	22	36	36	25	64	29	228
Estimated Tags	106	159	257	291	126	396	141	1476
Estimated Contrib.	5889	7227	9518	308	5727	409	1439	30517

Appendix Table 10. Observed and estimated recoveries of tags from 1974 brood year Spring Creek NFH adult chinook and estimates of their contribution to the Zone 6 fisheries.

Recovery Year	Tag Codes							All Codes
	9/1	10/1	11/1	12/1	13/1	14/1	15/1	
<u>1977</u>								
Observed Tags	1	1	4	11	8	18	6	49
Estimated Tags	23	23	124	334	191	441	147	1282
Estimated Contrib.	1278	1045	4593	354	8682	456	1490	17898
<u>1978</u>								
Observed Tags	6	11	23	25	9	29	15	118
Estimated Tags	29	50	123	120	41	145	82	590
Estimated Contrib.	1611	2273	4556	127	1864	150	837	11418
<u>1979</u>								
Observed Tags	0	2	1	1	0	1	0	5
Estimated Tags	0	7	3	4	0	3	0	17
Estimated Contrib.	0	318	111	4	0	3	0	436
<u>Total (1977-1979)</u>								
Observed Tags	7	14	28	37	17	48	21	172
Estimated Tags	52	80	250	458	232	589	228	1889
Estimated Catch	2889	3636	9260	485	10546	609	2327	29752

Appendix Table 11. Observed and estimated recoveries of tags from 1974 brood year Spring Creek NFH adult chinook and estimates of their contribution to Hatchery.

Recovery Year	Tag Codes							All Codes
	9/1	10/1	11/1	12/1	13/1	14/1	15/1	
<u>1977</u>								
Observed Tags	52	49	94	136	50	124	36	541
Estimated Tags	52	49	94	136	50	124	36	541
Estimated Contrib.	2889	2228	3491	144	2272	128	367	11508
<u>1978</u>								
Observed Tags	18	15	48	59	31	52	51	274
Estimated Tags	18	15	48	59	31	52	51	274
Estimated Contrib.	1000	681	1778	62	1409	53	520	5503
<u>1979</u>								
Observed Tags	2	1	1	1	0	0	0	5
Estimated Tags	2	1	1	1	0	0	0	5
Estimated Contrib.	111	45	37	1	0	0	0	194
<u>Total (1977-1979)</u>								
Observed Tags	72	65	143	196	81	176	87	820
Estimated Tags	72	65	143	196	81	176	87	820
Estimated Contrib.	4000	2953	5296	207	3681	181	887	17205
% Return to Hatchery	.074	.068	.142	.213	.083	.178	.090	.090

Appendix Table 12. Observed and estimated recovery of tags from 1974 brood year Spring Creek NFH adult chinook and estimates of their contribution to all areas (includes hatchery).

Recovery Year	Tag Codes							All Codes
	9/1	10/1	11/1	12/1	13/1	14/1	15/1	
<u>1977</u>								
Observed Tags	65	63	123	173	72	182	55	733
Estimated Tags	167	190	431	722	325	872	261	2968
Estimated Contrib.	9278	8636	15963	765	14772	901	2663	52978
<u>1978</u>								
Observed Tags	28	35	81	93	51	104	81	473
Estimated Tags	61	106	211	214	114	285	191	1182
Estimated Contrib.	3389	4817	7815	226	5182	294	1949	23672
<u>1979</u>								
Observed Tags	2	3	3	3	0	2	1	14
Estimated Tags	2	8	8	9	0	4	4	35
Estimated Contrib.	111	363	296	9	0	4	41	824
<u>Total (1977-1979)</u>								
Observed Tags	95	101	207	269	123	288	137	1220
Estimated Tags	230	304	650	945	439	1161	456	4185
Estimated Contrib.	12778	13816	24074	1000	19954	1199	4653	77474
% Return to Mouth of Columbia	.237	.319	.644	1.031	.451	1.181	.475	.406

x Table 13. Observed and estimated recoveries of tags from 1975 brood year Spring Creek NFH adult chinook, estimates of their contribution to the Zones 1-5 fisheries, and estimated strays returning to Bonneville Hatchery.

Recovery Year	Tag Code										All Codes
	1/2	2/2	3/2	4/2	5/2	6/2	7/2	8/2	9/2	10/2	
<u>8</u>											
Observed Tags											
-5 Fisheries	6	10	6	6	10	7	13	13	13	22	106
Bonneville Hatchery		1		1					1		3
Estimated Tags											
-5 Fisheries	21	34	23	22	40	28	52	59	50	91	420
Bonneville Hatchery		1		1					1		3
Estimated Contrib.											
-5 Fisheries	22	3400	676	23	41	30	1575	60	480	850	7157
Bonneville Hatchery		100		1					10		111
<u>9</u>											
Observed Tags											
-5 Fisheries	3	6	2	6	7	7	4	4	12	8	59
Bonneville Hatchery		1	2		2	1		1	1		8
Estimated Tags											
-5 Fisheries	11	22	9	24	29	27	15	15	48	30	230
Bonneville Hatchery		1	2		2	1		1	1		8
Estimated Contrib.											
-5 Fisheries	12	2200	265	25	30	29	455	15	461	280	3772
Bonneville Hatchery		100	59		2	1		1	10		173
<u>10</u>											
Observed Tags	0	0	0	0	0	0	0	0	0	1	1
Estimated Tags	0	0	0	0	0	0	0	0	0	1	1
Estimated Contrib.	0	0	0	0	0	0	0	0	0	10	10
<u>Total (1978-1980)</u>											
Observed Tags	9	18	10	13	19	15	17	18	27	31	177
Estimated Tags	32	58	34	47	71	56	67	75	100	122	662
Estimated Contrib.	34	5800	1000	49	73	60	2030	76	961	1140	11223

Appendix Table 14. Observed and estimated recoveries of tags from 1975 brood year Spring Creek NFH adult chinook and estimates of their contribution to the Zone 6 fisheries.

Recovery Year	Tag Code										All Codes
	1/2	2/2	3/2	4/2	5/2	6/2	7/2	8/2	9/2	10/2	
<u>1978</u>											
Observed Tags	12	8	15	19	17	16	19	21	11	9	147
Estimated Tags	53	37	76	90	86	74	94	102	59	45	716
Estimated Contrib.	56	3700	2235	93	88	78	2848	103	590	420	10211
<u>1979</u>											
Observed Tags	3	4	5	5	6	8	13	9	9	10	72
Estimated Tags	10	14	19	19	20	26	44	31	32	34	249
Estimated Contrib.	11	1400	559	20	21	27	1333	31	308	318	4028
<u>1980</u>											
Observed Tags	0	1	0	0	0	0	0	0	0	0	1
Estimated Tags	0	1	0	0	0	0	0	0	0	0	1
Estimated Contrib.	0	100	0	0	0	0	0	0	0	0	100
<u>Total (1978-1980)</u>											
Observed Tags	15	13	20	24	23	24	32	30	20	19	220
Estimated Tags	63	52	95	109	106	100	138	133	91	79	966
Estimated Contrib.	67	5200	2794	113	109	105	4181	134	898	738	14339

Appendix Table 15. Observed and estimated recoveries of tags from 1975 brood year Spring Creek NFH adult chinook and estimates of their contribution to hatchery.

Recovery Year	Tag Code										All Codes
	1/2	2/2	3/2	4/2	5/2	6/2	7/2	8/2	9/2	10/2	
<u>1978</u>											
Observed Tags	25	39	40	37	63	62	65	46	53	37	467
Estimated Tags	25	39	40	37	63	62	65	46	53	37	467
Estimated Contrib.	26	3900	1176	38	65	66	1970	47	495	346	8129
<u>1979</u>											
Observed Tags	6	7	12	16	12	10	16	14	23	33	149
Estimated Tags	6	7	12	16	12	10	16	14	23	33	149
Estimated Contrib.	6	700	353	17	12	11	485	14	220	308	2126
<u>1980</u>											
Observed Tags	0	0	0	0	0	0	0	0	0	0	0
Estimated Tags	0	0	0	0	0	0	0	0	0	0	0
Estimated Contrib.	0	0	0	0	0	0	0	0	0	0	0
<u>Total (1978-1980)</u>											
Observed Tags	31	46	52	53	75	72	81	60	76	70	616
Estimated Tags	31	46	52	53	75	72	81	60	76	70	616
Estimated Contrib.	32	4600	1529	55	77	77	2455	61	715	654	10255
Return to Hatchery	.031	.045	.053	.053	.074	.077	.080	.062	.149	.147	.058

Appendix Table 16. Observed and estimated recoveries of tags from 1975 brood year Spring Creek NFH adult chinook, and estimates of their contribution to all areas. (includes hatchery).

Recovery Year	Tag Code										All Codes
	1/2	2/2	3/2	4/2	5/2	6/2	7/2	8/2	9/2	10/2	
<u>1978</u>											
Observed Tags	43	58	61	63	90	85	97	80	78	68	723
Estimated Tags	99	111	139	150	189	164	211	207	163	173	1606
Estimated Contrib.	104	11100	4087	155	194	174	6393	210	1575	1616	25608
<u>1979</u>											
Observed Tags	12	18	21	27	27	26	33	28	45	51	288
Estimated Tags	27	44	42	59	63	64	75	61	104	97	636
Estimated Contrib.	29	4400	1236	62	65	68	2273	61	999	906	10099
<u>1980</u>											
Observed Tags	0	1	0	0	0	0	0	0	0	1	2
Estimated Tags	0	1	0	0	0	0	0	0	0	1	2
Estimated Contrib.	0	100	0	0	0	0	0	0	0	10	110
<u>Total (1978-1980)</u>											
Observed Tags	55	77	82	90	117	111	130	108	123	120	1013
Estimated Tags	126	156	181	209	252	228	286	268	267	271	2244
Estimated Contrib.	133	15600	5323	217	259	242	8666	271	2574	2532	35817
% Return to Mouth of Columbia	.131	.153	.186	.210	.249	.242	.282	.275	.532	.567	.204